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(54) **Position sensor for a gas pedal**

(57) In order to achieve greater wear resistance, more robustness, and a longer service life, a position sensor for a gas pedal in motor vehicles which generates an actuating signal as a function of the gas pedal position has an elastically deformable component (10), in the deformation region of which a strain gauge (15) is mounted. The strain gauge (15) is connected to an electrical evaluation unit (16) which converts a change in resistance of the strain gauge (15), which participates in the deformation of the component (10) upon actuation of the gas pedal, into an electrical actuating signal.

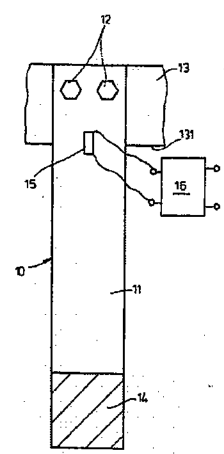

Fig. 1

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Background

The invention is directed to a position sensor for a gas pedal in motor vehicles, of the species defined in the preamble of Claim 1.

Such position sensors are used as setpoint generators for electronic actuation or control devices for actuating the air or fuel metering systems in internal combustion engines. The actuation or control device acts, for example, on the throttle valve or the injection pump for the internal combustion engine. The position sensor is actuated by the gas pedal and specifies the desired setpoint.

In one known position sensor of this type (DE 34 11 456 A1) the slider of a potentiometer rests on an encoder shaft which is coupled to the gas pedal. The reduction in voltage at the potentiometer is a measure of the gas pedal position and is converted into a corresponding actuating signal. The gas pedal and the encoder shaft are generally coupled via a lever rod system which converts the swivel motion of the gas pedal into a rotary motion of the encoder shaft.

Advantages of the Invention

The position sensor according to the invention has the advantage that it requires no slider or slide rings, is resistant to wear and therefore has a long service life, and as a whole has greater functional reliability. The number of individual parts required is drastically reduced, thereby increasing the functional reliability of the overall system and reducing the manufacturing costs. The position sensor according to the invention is also extremely compact, and requires only a small installation space in the vehicle. The position sensor may be provided as a component having universal application for any model, and requires only that the gas pedal be affixed thereto. By use of the position sensor according to the invention it is also possible to achieve an optimal torque curve for the gas pedal as a function of the actuation angle thereof.

Advantageous refinements and improvements of the position sensor described in Claim 1 are provided by the features stated in the further claims.

In a first embodiment of the invention, the elastically deformable component is formed by a leaf spring clamped at one end, the free end of which is impinged on by the gas pedal approximately transverse to the longitudinal axis of the leaf spring. It is preferable for the leaf spring itself to constitute the gas pedal, the non-clamped free end of the leaf spring bearing a rubber coating on which the foot rests. The strain gauge is situated on the surface of the leaf spring, in the bending region thereof at the clamped location. This structural design represents the simplest version, distinguished by its cost advantages.

In one preferred embodiment of the invention, the elastically deformable component is formed by a leaf spring clamped at both ends, the strain gauge being mounted to the leaf spring approximately in the center thereof. The bending spring is impinged on by a force, which is a function of the swivel path of the gas pedal, in the region of the strain gauge on the surface of the bending spring facing away from the strain gauge, approximately transverse to the direction of extension of the spring.

In a first embodiment, the force on the leaf spring is exerted by an eccentric which is able to swivel about a rotational axis, and which rests against the leaf spring and has an increasing radius over the swivel angle. A swivel arm which extends transverse to the rotational axis and is coupled to the gas pedal is rigidly connected to the eccentric. When the gas pedal is actuated the eccentric rotates and causes the leaf spring to deflect. The strain gauge participates in the deformation and undergoes a change in resistance. The spring upon relaxation returns the gas pedal to its rest position by means of the eccentric. This requires only a proper coordination of the leaf spring and eccentric. The friction between the eccentric and the leaf spring results in desired stabilization of the pedal position. For vehicles having automatic transmissions, a cam may be provided on the eccentric for producing the "kick-down" effect.

In a second embodiment of the invention, the force which impinges on the leaf spring approximately at the center thereof is exerted by a nose of a swivel arm which rests against the leaf spring and which is held in at least one oblong hole, extending approximately perpendicularly to the leaf spring, in a rotatable and axially displaceable manner. The swivel arm is supported by a member whose curved path forces the nose to undergo axial displacement toward the leaf spring when the swivel arm performs a swivel motion. The swivel arm in turn is coupled to the gas pedal. Actuation of the gas pedal causes the swivel arm to swivel in the oblong hole. The swivel is supported by the member and is axially displaced in the oblong hole with respect to the leaf spring. This causes the leaf spring to deflect. The strain gauge mounted in the deflection region of the leaf spring participates in the deformation and undergoes a change in resistance. Here as well, the spring upon relaxation returns the gas pedal to its rest position by means of the swivel arm. This requires a proper coordination of the leaf spring and the curved path of the member.

By optimal design of the curved path it is possible to realize all desired torque paths of the gas pedal over the actuating angle. For vehicles having automatic transmissions, a cam may be provided on the curve path for producing the "kick-down" effect.

Brief Description of the Drawing

The invention is explained in greater detail in the description below, with reference to the exemplary embodiments illustrated in the drawing, which shows the following:

Figures 1 and 2	show a position sensor according to a first exemplary embodiment, seen in the top view (Figure 1) and the side view (Figure 2);
Figure 3	shows a top view of a position sensor according to a second exemplary embodiment;
Figure 4	shows a section along the line IV-IV in Figure 3;
Figure 5	shows a top view of a position sensor according to a third exemplary embodiment, in a partial section; and
Figure 6	shows a section along the line VI-VI in Figure 5.

Detailed Description of the Exemplary Embodiments

The position sensor for a gas pedal in motor vehicles, illustrated in Figures 1 and 2, represents a very simple version. The position sensor has an elastically deformable component 10 in the form of a leaf spring 11 clamped at one end, the leaf spring on one end being attached to a plate 13 by means of two screws 12. At its opposite, free end the leaf spring 11 bears a rubber coating 14 which is used as a support surface for the foot of the driver. The leaf spring 11 has a length such that it simultaneously forms the gas pedal for the motor vehicle. When the driver's foot resting on the rubber coating 14 applies a force in the direction of the arrow 17 (Figure 2), the leaf spring 11 deflects in the region of its clamped location at the lower edge 131 of the plate 13. A strain gauge 15 is provided in this deformation region, specifically, on the same upper side of the leaf spring 11 on which the rubber coating 14 is mounted. The deflection of the leaf spring 11 causes the strain gauge 15 to extend, thereby changing its electrical resistance. As the result of this change in resistance an electrical actuating signal is generated in an evaluation unit 16 which is electrically connected to the strain gauge 15, this signal being a measure of the magnitude of extension of the strain gauge 15 and therefore a measure of the deflection of the leaf spring 15 resulting from the force acting in the direction of the arrow 17.

The evaluation unit is not illustrated in detail, and represents prior art. As an example, the strain gauge 15 may be integrated into a full bridge circuit which is balanced, i.e., is without current, when the gas pedal is not actuated. As a result of the change in resistance of the strain gauge 15 caused by actuation of the gas pedal, this balance is upset, and a current flows in the bridge branch which is a measure of the deflection of the gas pedal.

In the position sensor illustrated in Figures 3 and 4, the elastically deformable component 10 once again is formed by a leaf spring 21, which, however, in this case is clamped on both sides and is impinged on by a force, transverse to the direction of extension of the leaf spring and approximately in the center thereof, when the gas pedal is actuated. The leaf spring 21 rests in a U-shaped holder 22 and spans a recess 24 formed in the crossbar 23 for the holder 22, the leaf spring resting only on its two narrow end sides on the transverse bar 22. A slide bore 27, 28 is respectively provided in each of the two approximately trapezoidal legs 25, 26 of the holder 22. The two slide bores 27, 28 accommodate a rotatable shaft 29 on which a rotationally fixed eccentric 18 rests. To the eccentric 18 is attached a swivel arm 30 which on its free end bears a plug element 19 for affixing a gas pedal 20 thereto. When the gas pedal 20 is not actuated, the eccentric 18 rests against the leaf spring 21 at the center region thereof without exerting force thereon. The eccentric 18 is designed in such a way that its radius increases over the angle of rotation, so that rotation of the eccentric 18 causes the leaf spring 21 to become increasingly deflected. As a result of the rotationally fixed connection of the eccentric 18 to the gas pedal 20 via the swivel arm 30, the magnitude of deflection by the leaf spring 21 is therefore a measure of the position of the gas pedal 20.

The strain gauge 15 is mounted on the surface of the leaf spring 21 facing away from the eccentric 18 and opposite therefrom, so that the strain gauge participates in the deformation of the leaf spring 21. When the leaf spring 21 deflects, the strain gauge is extended and undergoes a change in resistance. In the evaluation unit 16 the change in resistance is converted to an actuating signal which specifies a setpoint value for the setting of the throttle valve or the injection valve. Four fastening holes 52 are provided for mounting the holder 22 in the vehicle.

In the position sensor illustrated as a further exemplary embodiment in Figures 5 and 6, the

elastically deformable component 10 once again is formed by a leaf spring 31 which is clamped on both sides, and similarly as in Figures 3 and 4 is accommodated in a U-shaped holder 32 such that it covers a recess 34 in the crossbar 33 of the holder 32 and rests only on its two narrow ends on the crossbar 33. In the center region of the leaf spring 31 a swivel arm 40 having a nose 41 rests against the surface of the leaf spring 31 facing away from the crossbar 33, the swivel arm holding the leaf spring 31 in its described position in the holder 32 in such a way that, similarly as in Figures 3 and 4, a special attachment of the leaf spring 31 to the crossbar 33 is unnecessary. As shown in particular in Figure 5, oblong holes 37, 38 are provided in the two arms 35, 36 which accommodate a shaft 39 which is rotatable and axially displaceable. The oblong holes 37, 38 which run in parallel extend transverse to the longitudinal extension of the leaf spring 31. The swivel arm 40 together with the nose 41 is connected to the shaft 39 in a rotationally fixed manner.

The two legs 35, 36 are connected to one another, at their ends facing away from the crossbar 33, by a cover plate 42 which has a through opening 43 for the swivel arm 40. On the inner surface of the cover plate 42 a curved path 44 is provided on which the swivel arm 40, which together with its nose 41 rests against the leaf spring 31 and which in its front region has an angled design, is supported by a guide member 45. The curved path 44 is designed so that in the normal position of the swivel arm 40 the nose 41 rests against the leaf spring 31 without deforming same, and in such a way that, as the swivel angle of the swivel arm 40 increases, the curved path 44 via the guide member 45 increasingly displaces the swivel arm 40 together with its shaft 39 in the oblong holes 37, 38 toward the leaf spring 31. In the exemplary embodiment in Figures 5 and 6, the guide member 45 is designed as a ball bearing or roller bearing 46, the inner bearing ring 47 of which rests in a rotationally fixed manner on an insertion axis 49 which is held in two parallel lugs 50, 51 which project from the swivel arm 40, and the outer bearing ring 48 of which rests against the curved path 44. The swivel arm 40 once again bears at its free end the plug element 19 to which the gas pedal 20 is affixed. The holder 32 bears four fastening holes 52 through which fastening screws (not illustrated) project in order to attach the holder 32 in the motor vehicle.

The strain gauge 15 once again is attached in the center region of the leaf spring 31, specifically, on the surface of the leaf spring 31 facing away from the swivel arm 40, so that when the leaf spring 31 deflects as a result of the swivel motion of the swivel arm 40 the strain gauge participates in the deformation of the leaf spring and is extended. In the evaluation unit 16 the resulting change in resistance of the strain gauge 15 is converted to an actuating signal which once again serves as a setpoint value for actuating the air or fuel metering system of the internal combustion engine in the vehicle. By appropriate design of the curved path 44, it is possible to realize all desired torque curves for the gas pedal 20 over the actuation angle thereof. When the leaf spring 31 and the curved path 44 are properly coordinated, upon relaxation the gas pedal 20 is returned to its rest position. The friction between the swivel arm 40 and the leaf spring 31 results in desired stabilization of the pedal position in the normal setting.

Claims

1. Position sensor for a gas pedal in motor vehicles which generates an electrical actuating signal, the magnitude of which is determined by the gas pedal position, characterized by a component (10) which is elastically deformable upon actuation of the gas pedal and in the deformation region of which a strain gauge (15) is mounted, and an evaluation unit (16) electrically connected to the strain gauge (15) which converts a change in resistance of the strain gauge (15) into an electrical actuating signal.

2. Position sensor according to Claim 1, characterized in that the elastically deformable component (10) is formed by a leaf spring (11) clamped at one end, the free end of which is impinged on by the gas pedal approximately transverse to the longitudinal axis of the leaf spring (11), and the strain gauge (15) is situated on the surface of the leaf spring (11), in the bending region thereof at the clamped location.

3. Position sensor according to Claim 3, characterized in that the leaf spring (11) itself constitutes the gas pedal, the non-clamped free end of the leaf spring bearing a rubber coating (14) on which the foot of the driver rests.

4. Position sensor according to Claim 1, characterized in that the elastically deformable component (10) is formed by a leaf spring (21; 31) clamped at both ends, the strain gauge (15) being attached to the leaf spring approximately in the center thereof, and the leaf spring (21; 31) is impinged on by a force, which is a function

of the swivel path of the gas pedal (20), in the region of the strain gauge (15) on the upper side of the leaf spring facing away from the strain gauge, approximately transverse to the direction of extension of the spring.

5. Position sensor according to Claim 4, characterized in that the force is exerted by an eccentric (18) which is able to swivel about a rotational axis (29) and which rests against the leaf spring (21) and has an increasing radius over the swivel angle, and a swivel arm (30) which extends transverse to the rotational axis (20) and may be coupled to the gas pedal (20) is rigidly connected to the eccentric (18).

6. Position sensor according to Claim 5, characterized in that the leaf spring (21) is clamped in a U-shaped holder (22) comprising two legs (25, 26) and a crossbar (23) which connects the legs (25, 26), and the crossbar has a recess (24) which is spanned by the ends of the leaf spring (21) resting on the crossbar (23), and the eccentric (18) rests in a rotationally fixed manner on a shaft (29) which is pivotably supported in the two legs (25, 26) of the holder (22).

7. Position sensor according to Claim 4, characterized in that the force is exerted by a nose (41) of a swivel arm (40) which rests against the leaf spring (31) and which is held in at least one oblong hole (37, 38), extending approximately perpendicularly to the leaf spring (31), in a rotatable and axially displaceable manner, and the swivel arm is supported by a member (42) whose curved path (44) forces the nose (41) to undergo axial displacement toward the leaf spring (31) when the swivel arm (40) performs a swivel motion, and the swivel arm (40) may be coupled to the gas pedal (20).

8. Position sensor according to Claim 7, characterized in that the leaf spring (31) is clamped in a U-shaped holder (32) bearing two legs (35, 36), a crossbar (33) connecting same, and a cover plate (42) parallel to the crossbar (33) having a through opening (43) for the swivel arm (40), and the crossbar (33) has a recess (34) which is spanned by the ends of the leaf spring (31) resting on the crossbar (33), and the swivel arm (40) is connected in a rotationally fixed manner to a shaft (39) which at each end rests in a respective oblong hole (37, 38) in the arms (35, 36), at the center of the leaf spring (31), and the curved path (44), on which the swivel arm (40) is supported by a guide member (45), is provided on the surface of the cover plate (42) facing the leaf spring (31).

9. Position sensor according to Claim 8, characterized in that the guide member (45) is a roller element (46) which is rotatably supported in two lugs (50, 51) which project from the swivel arm (40).

10. Position sensor according to Claim 9, characterized in that as roller element a ball bearing or roller bearing (46) is used, the inner bearing ring (47) of which rests in a rotationally fixed manner on an insertion axis (49) which is held in the lugs (50, 51), and the outer bearing ring (48) of which rests against the curved path (44).

11. Position sensor according to one of Claims 6 through 10, characterized in that the holder (22, 32) has bores (52) for inserting fastening means.

12. Position sensor according to one of Claims 5 through 11, characterized in that the swivel arm (30; 40) bears a plug element (19) for affixing the gas pedal (20) thereto.

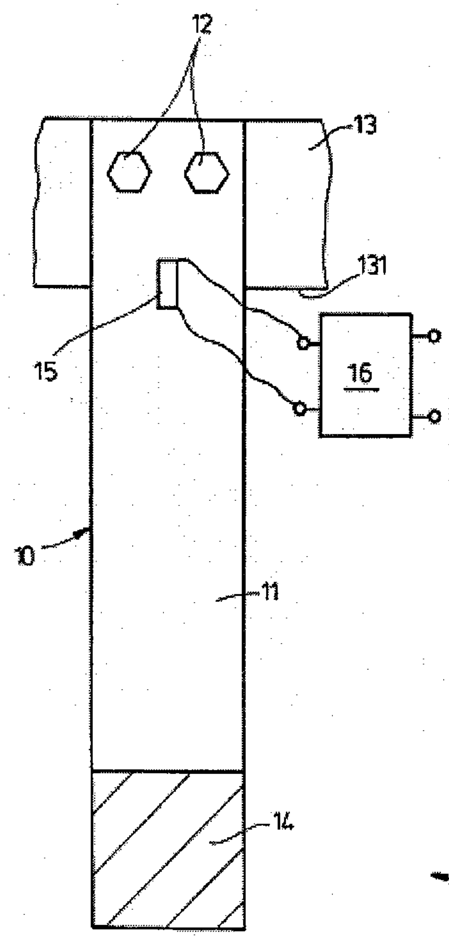

Fig. 1

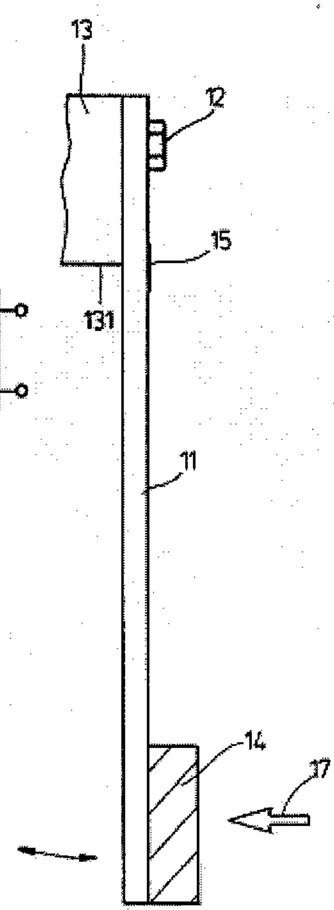

Fig. 2

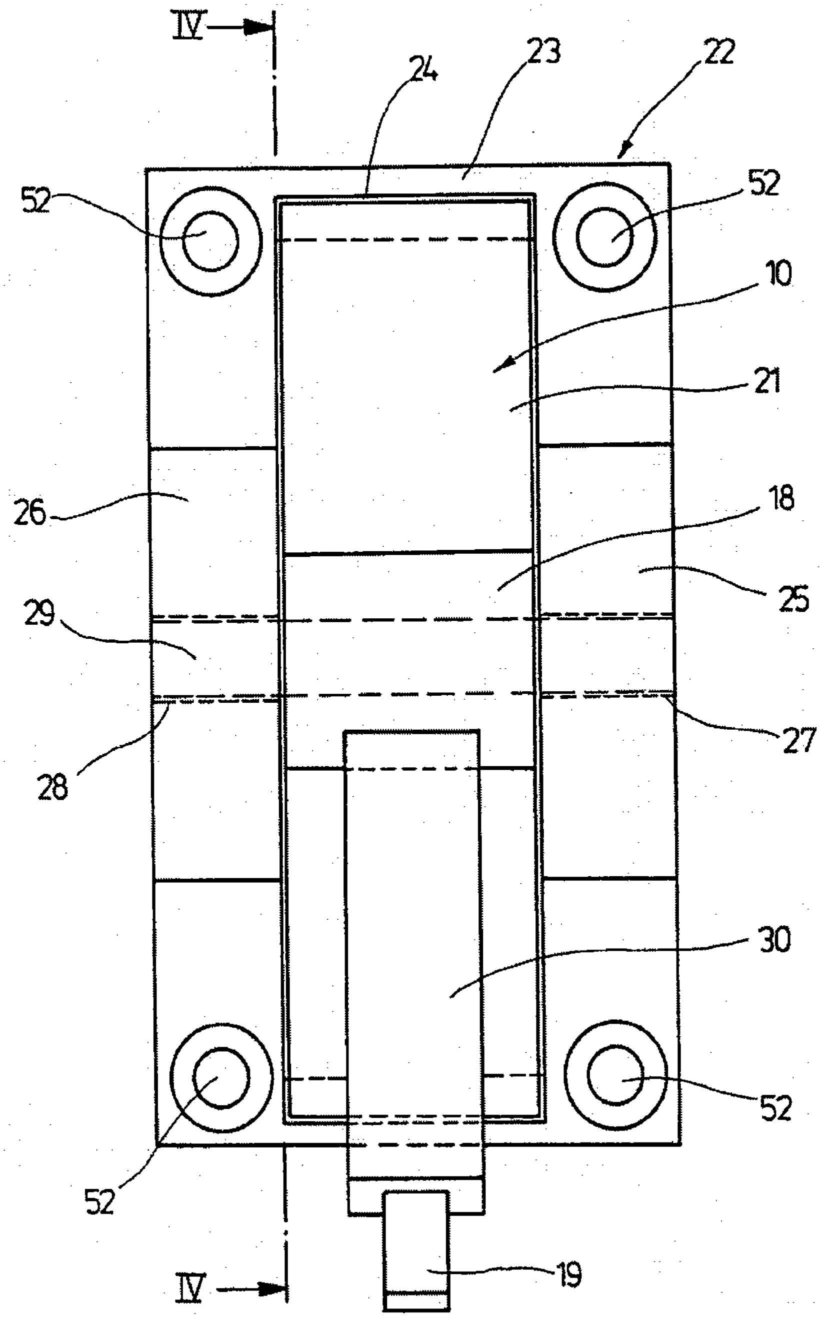

Fig. 3

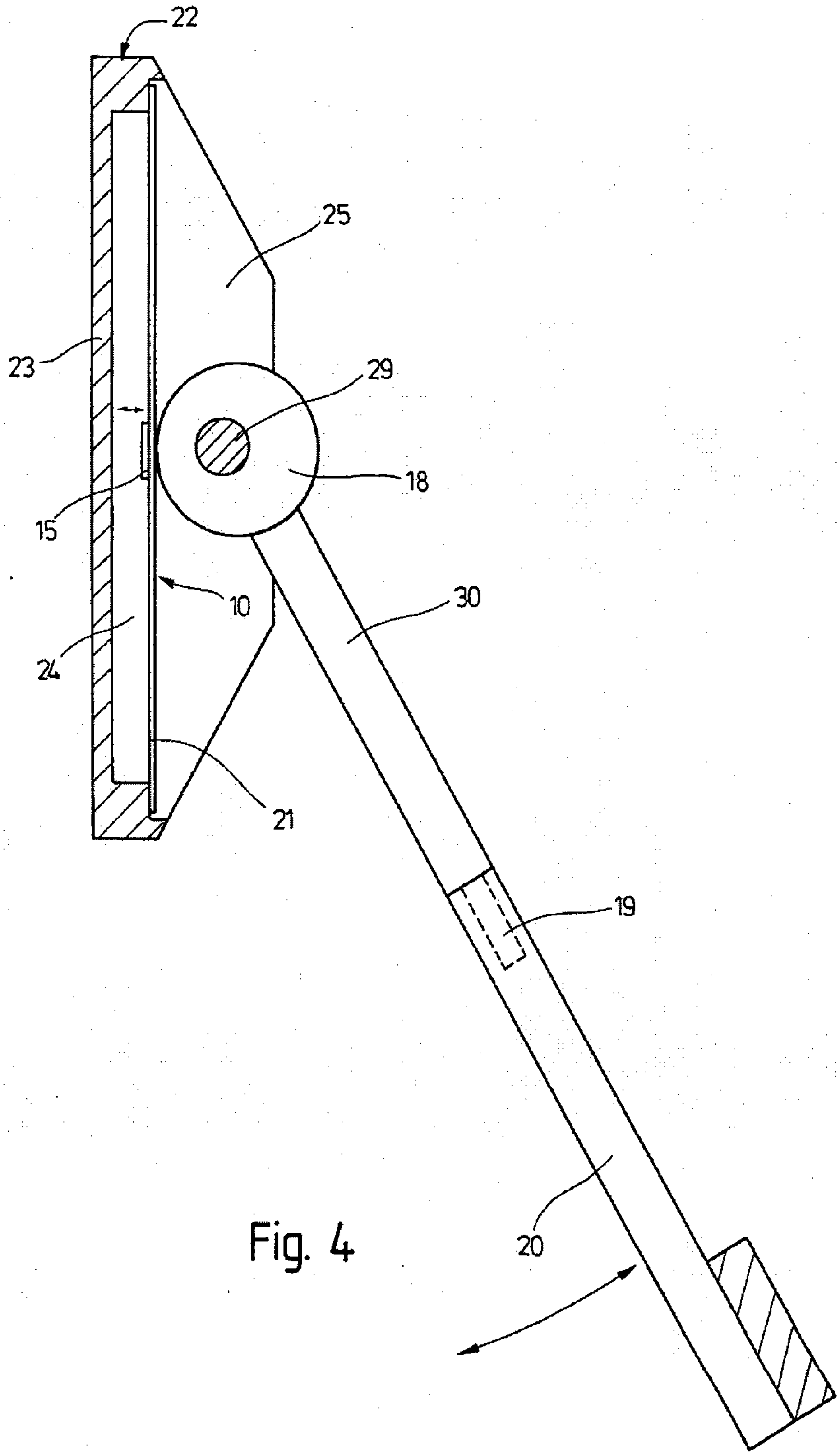

Fig. 4

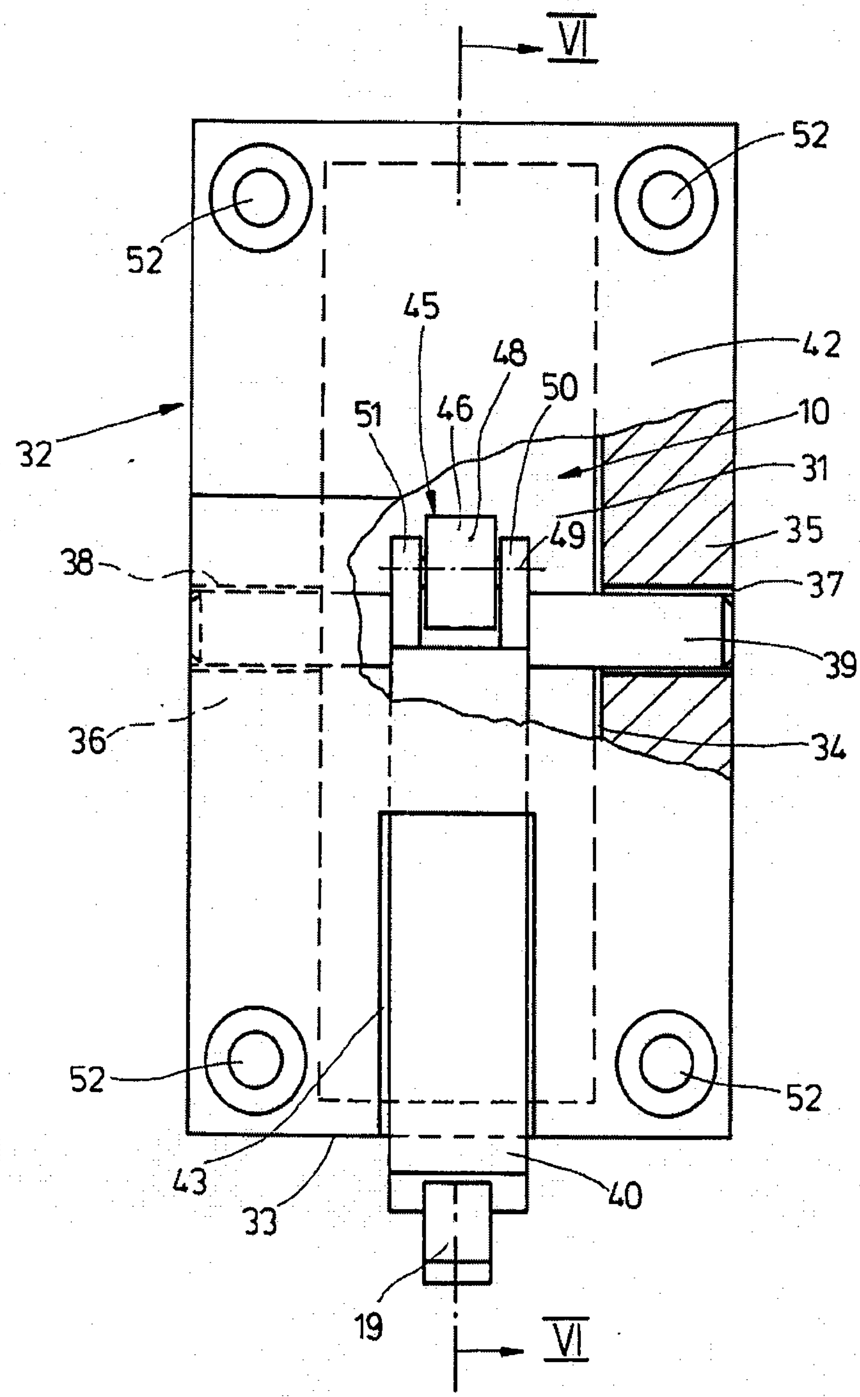
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Fig. 5

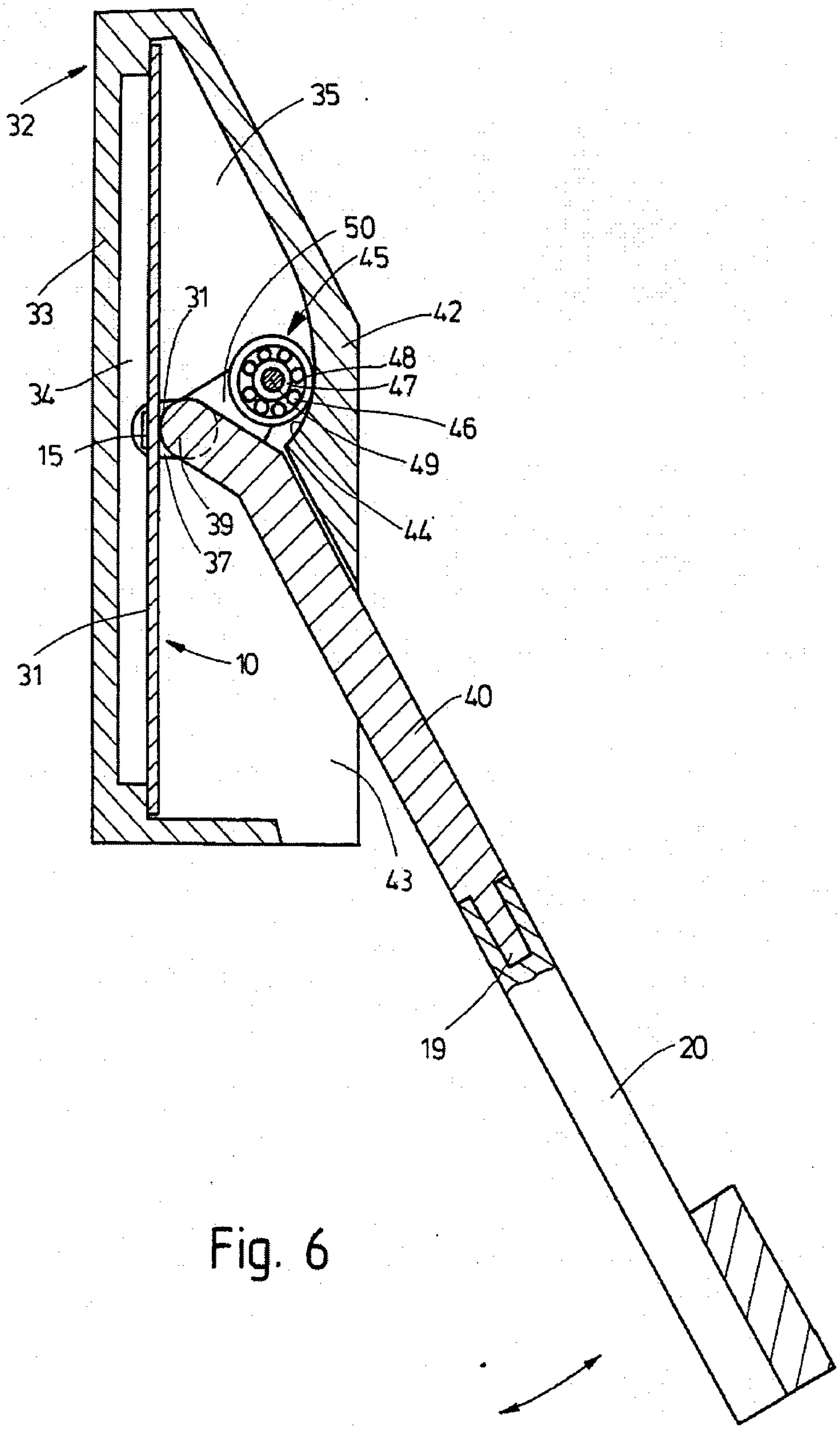

Fig. 6